Effects of ECB's Corporate Sector Purchase Programme on the European corporate bond market

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Tiivistelmä
2000-luvulla alkanut maailmanlaajuinen talouskriisi on pakottanut monet keskuspankit laajentamaan rahapolitiikan instrumenttejaan. Ennen kriisiä, rahapolitiikan pääasiallinen instrumentti oli keskuspankin ohjauskorko. Kun korot laskivat nollaan, keskuspankkien oli otettava käyttöön uusia rahapolitiikan instrumentteja. Laajat omaisuuserien osto-ohjelmat ovat yksi tällaisista niin kutsutuista epätavanomaisista rahapolitiikan instrumenteista. Euroopan keskuspankki (EKP) laajensi aikaisempia osto-ohjelmiaan vuonna 2016, kun se ilmoitti aloittavansa yrityslainojen ostot. EKP:n motivaatio yrityssektorin velkapapereiden osto-ohjelman (CSPP) aloittamiseen oli tukea jo käytössä olevia epätavanomaisen rahapolitiikan keinoja, jotta inflaatio saataisiin nousemaan lähelle tavoitetasoaan. Tutkielman tarkoituksena on tutkia CSPP:n julkistamisen vaikutuksia talouteen ja selvittää, mitkä ovat mahdollisten vaikutusten välittymiskanavat. Tutkielma keskittyy tutkimaan yrityslainojen tuottojen ja korko-odotusten muutoksia ohjelman julkistamispäivinä.

Tutkimuksen kohteena ovat kahden joukkovelkakirjaindeksin tuottojen sekä korkojen vaihdantasopimusten hintojen muutokset. Muutoksia tutkitaan valittuina tapahumapäivinä käyttäen event study -menetelmää.Tutkimuksen kohteena ovat myös EKP:n keräämän ekonomistien kyselytutkimuksen (The Survey of Professional Forecasters tai SPF) tulokset korkoennusteista. Tutkitaan, kuinka korkoennusteet muuttuivat niiden kyselyiden välillä, jotka suoritettiin ennen ja jälkeen CSPP:n julkistamisen. Tulokset osoittavat, että CSPP:n julkistaminen laski molempien tutkittujen joukkovelkakirjaindeksien tuottoja. Välittymiskanavista todisteita löydetään portfoliokanavalle, duraatioriskikanavalle, paikallisen tarjonnan kanavalle sekä signalointikanavalle. Tulokset ovat linjassa EKP:n aikaisemmista osto-ohjelmista tehtyjen tutkimusten tuloksien kanssa.

Tulevaisuuden, elpyneen talouden, rahapolitiikan muoto ei ole vielä selvillä. Tällä hetkellä keskuspankeilla on suuria määriä osto-ohjelmia varten ostettuja omaisuuseriä taseissaan. Osto-ohjelmien purkaminen on tehtävä varoen ja kestää luultavasti useita vuosia. Ennakoivan viestinnän tärkeys korostuu, kun EKP alkaa ajaa alas osto-ohjelmiaan.

Avainsanat
määrällinen elvyttäminen
epätavanomainen rahapolitiikka
osto-ohjelmat

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Abstract
The global financial crisis that started in the beginning of the 21st century has forced many central banks to expand their range of monetary policy instruments. Before the crisis, the main monetary policy instrument was the policy interest rate. When the policy rates hit the zero lower bound, the central banks needed to implement new monetary policy measures. One of these so called unconventional monetary policy measures is extensive purchase programmes. European Central Bank (ECB) expanded its existing purchase programmes in 2016 when it announced that it will start purchasing corporate bonds. ECB's motivation to start the corporate sector purchase programme (CSPP) was to support the already existing unconventional monetary policy measures to attain the inflation rate of near but under 2 %. The object of thesis is to study did the announcement of CSPP affect the economy and what was the mechanism behind the possible effects. Thesis concentrates to examine the changes on corporate bond yields and changes on the interest rate expectations.

Yield reactions of two bond indexes and the price reactions of interest rate swap contracts are studied on the CSPP related announcement dates using event study methodology. The Survey of Professional Forecasters (SPF) conducted by ECB is studied to determine the possible changes in interest rate expectations of the forecasters before and after the CSPP announcement. Results show that the CSPP related announcements decreased bond yields of both bond indexes. Evidence supporting the portfolio balancing channel, duration risk channel, local supply channel and signalling channel are found. Results are in line with the other studies regarding ECB's previous purchase programmes.

The form of future monetary policy, after the economy has recovered, is still unknown. Currently, central banks have massive holdings of assets purchased under various programmes and the dissolution of the purchase programmes need to be done carefully and will probably take several years. Forward guidance will be on important role when ECB starts to shut down the purchase programme.

Keywords
quantitative easing
unconventional monetary policy
purchase programmes

Contents

1 Introduction

Central banks have introduced different kind of purchase programmes during the recent decade to expand their range of monetary policy instruments. Previously the main monetary policy instrument was the policy interest rate. When the policy rates hit the zero lower bound, the central banks needed to implement new monetary policy measures, including asset purchase programme. Euroarea inflation started to decrease on the beginning of 2012 and kept lowering until it went negative on the end of 2014. ECB decreased its policy rate multiple times, starting from the middle of 2011. ECB's deposit facility rate hit zero on November 2013. ECB started the public sector purchase programme in January 2015 to stimulate the economy and help the inflation to get more close to ECB's target rate.

ECB expanded the existing purchase programmes in 2016 when it announced that it will start purchasing corporate bonds. The first official announcement to start the programme was made in March 2016 and the purchases started on June 2016. ECB's motivation to start the corporate sector purchase programme (CSPP) was to support the already existing unconventional monetary policy measures to attain the inflation rate of near but under 2 %. The object of my thesis is to study did the announcement of CSPP affect the economy and what was the mechanism behind the possible effects. I will concentrate my study to examine the changes on corporate bond yields and changes on the interest rate expectations.

My hypothesis is that the yields of bonds that are eligible for CSPP purchased decreased after the ECB's announcement of the programme. If the arbitrageurs in the corporate programme market have a special demand for bonds with certain maturity, the yields may decrease also for bonds that are not eligible for purchases but have the same maturity structure than the bonds that ECB is purchasing. Bonds with

long maturity have higher duration risk than the bonds with smaller maturities. If the ECB's purchases have decreased the duration risk, the yields of long maturity bonds should have decreased more than the yields of bonds with small maturity. Besides the effect on bond yields, the announcement of the CSPP have probably affected the expectations about ECB's future policy rate. When ECB commits to buy bonds it gives a signal to the market that it will not increase the policy rate in the near future. I will study if the CSPP announcement affected the economy through this so-called signalling channel.

Most of the studies regarding the purchase programmes are from the recent 15 years. The increased implementation of purchase programmes and other unconventional monetary policy measures has motivated the researchers. The studies regarding the purchase programmes generally agrees with the effect of the programme and disagree with the magnitude and persistence. Programmes that have been introduced in the most turbulent financial situations are noticed to have larger effects on the economy (Altavilla et al., 2015).

Different purchase programmes affect the economy through different transmission channels, depending on the characteristics of the assets being purchased and their maturities. Event studies are a common method used when studying the effects of purchase programmes. Event studies are usually used when assessing the immediate effect of the announcement to start a certain purchase programme have on the economy. Most of the purchase programme related event studies study the effect of the announcement to asset yields, but also the effects to equity prices or interest rates are studied.

In the empirical part of my thesis, I study the effects of CSPP related announce-

ments on bond yields. I do an event study to examine how the announcements affected yields of the bonds being purchased and I will also study if the announcement cause spillover to the bonds that are not eligible for CSPP purchases. Besides the yield effects, I also assess whether the announcements changed the expectations of ECB's future policy rate. I use the prices of interest rate swap contracts as a proxy of ECB's policy rate. I do an event study on how swap prices with different maturities reacted to the CSPP related announcements.

CSPP is very recent programme and the research done regarding it is yet limited. The main motivation for my thesis is to fill this gap. Even though ECB's other purchase programmes and especially the public sector purchase programme (PSPP) has been studied, the transmission mechanisms can be completely different on each purchase programme. Studies regarding the corporate sector purchase programmes of other central banks can be helpful but not fully comparable, because every country and its bond market have its own characteristics that can affect the functionality of the purchase programme. The point of time of the implementation of the programme and the financial situation of that time also affects the effectiveness of the programme.

The structure of my thesis is the following. The institutional background of the purchase programmes are describes on chapter 2 and review of the previous literature regarding them on chapter 3. The empirical part of my thesis follows that on chapters 4-6. The strategy for my empirical is described on chapter 4. Chapter 5 describes the data used and the way that it has been collected.The results are describes on chapter 5 and the final chapter concludes the thesis.

2 Institutional Background

The global financial crisis that started in the beginning of the 21st century has forced many central banks to expand their range of monetary policy instruments. Before the crisis, the main monetary policy instrument was the policy interest rate. When the policy rates hit the zero lower bound, the central banks needed to implement new monetary policy measures. One of these so called unconventional monetary policy measures is extensive purchase programmes. Central banks purchase large quantities of predetermined type of assets from the markets. Federal Reserve System, Bank of England, Bank of Japan and European Central Bank are the central banks that have had the most extensive purchase programmes.

ECB's monetary policy target is to keep inflation rate near but under 2%. To achieve this, ECB uses different kind of monetary policy measures. ECB's so-called conventional monetary policy measures are main refinancing operations and interest rate for marginal lending facility and deposit facility. Marginal lending facility interest rate is the rate that banks have to pay to get overnight credit from ECB. Deposit facility interest rate is the rate that banks get for their overnight deposits at ECB. These two rates set a corridor to the market interest rates. The marginal lending facility rate is the ceiling rate for euro area overnight credit. Banks do not take credit from the markets with higher interest rate than the ECB's marginal lending rate, because they always have the option to take overnight credit from ECB with the marginal lending rate. The deposit rate is the floor rate for euro area overnight deposits. Banks do not deposit money with smaller interest rate than the deposit rate, because they can always deposit the money to the central bank with the deposit rate.

Main refinancing operations (MROs) are in the normal financial situation the main liquidity provider for the euro area banking system. Technically MRO is a liquidity-

providing reverse transaction. Practically MRO is credit from ECB to banks for one week against sufficient collateral. Before the financial crisis, the MROs were distributed so, that ECB set the minimum rate and the total amount of credit to be distributed. After that, the banks were able to leave tenders about that included how much they want credit and on what price. The MRO credit was allocated based on these tenders. Currently, ECB is practising a fixed-rate full-allotment policy. That means, that ECB has defined the rate for MRO (currently[1] 0,00%) and banks choose how much they want to lend with the predetermined rate. The frequency for MRO is still one week. Besides the MROs, ECB has also other open market operations with longer maturity. Longer-term refinancing operations (LTROs) have a maturity of three months. The 3-month LTROs are organized monthly. ECB can also conduct fine-tuning operations and structural operations when they find the need.

ECB's interest rate based monetary policy is not a peculiarity. Before the financial crisis, interest rates were the most effective and most used monetary policy instrument. Problems arose when interest rates started to approach zero and the economic activity was still in unusually low level. Central banks reacted by introducing different kind of unconventional monetary policies that often included central bank's balance sheet. Borio & Diyatat (2010) call these kind of policies balance sheet policies. They divide balance sheet policies to four different categories: exchange rate policy, quasi-debt management policy, credit policy and bank reserves policy. By purchasing assets from the private sector, the central bank practices quasi-debt management policy, credit policy, bank reserves policy or mixture of these policies depending on the targeted assets. They also point out that one of the good qualities of different kind of balance sheet policies is that they can be implemented separately

[1] July 2017

from the interest rate policy. Stone et al. (2011) use a different kind of classification of balance sheet policies. They divide policies to financial stability and macroeconomic stability policies.

The purchase programmes have become a common monetary policy tool in the recent years. Gambacorta et al. (2014) even states that the central bank balance sheets have replaced interest rates as the main monetary policy instrument. The general idea of a asset purchase programme is to operate directly on different segments of the asset's yield curve and reduce interest rates at different maturities (Chen et al., 2012). By purchasing assets, the central bank can affect the private sector balance sheets. The central bank can also provide liquidity to the malfunctioning parts of the financial markets. Providing liquidity has an important role, because stressed financial markets can jeopardize the activity of the real market. (Stone et al., 2011). Asset purchase programmes can affect the economy through different transmission channels. Some of the channels are described in chapter 3.

ECB is one of the central banks that have introduced new unconventional monetary policy instruments after the financial crisis. When the key monetary policy interest rates hit the zero lower bound, ECB needed to find new ways to ensure the price stability and the liquidity in the banking system. The unconventional monetary policy measures of ECB are extended asset purchase programme (APP or EAPP in some literature), LTROs with longer maturity than the the original 3 months, targeted longer term refinancing operations (TLTROs), forward guidance and the expansion of the list of collateral eligible for the credit operations.

When executing the asset purchase programmes, ECB buys public and private sector assets monthly with predefined amount. ECB's current extended asset purchase

programme (APP) consists four different purchase programmes. These four purchase programmes are: third covered bond purchase programme (CBPP3), asset-backed securities purchase programme (ABSPP), public sector purchase programme (PSPP) and corporate sector purchase programme (CSPP). ECB has executed also three already terminated purchase programmes: covered bond purchase programme (CBPP), covered bond purchase programme 2 (CBPP2) and Securities Market Programme (SMP).

ECB expanded its asset purchase programmes to puclic sector bonds in the beginning of 2015 when it introduced the PSPP. The main goal of the expanded asset programme was and still is to prevent the inflation from getting too low for too long period. Figure 1 represents the cumulative Eurosystem holdings of assets under different purchase programmes. PSPP is definitely ECB's largest programme measured in purchase volumes. The current purchase programmes are continued at least until the end of 2017 with a monthly amount of 60 billion euros. The APP and TLTROs together form an unconventional monetary package of ECB.

The oldest ones of the ECB's current purchase programmes are third covered bond purchase programme (CBPP3) and asset-backed securities purchase programme (ABSPP). Both programmes were announced on October 2014[2]. In its decision ECB/2014/40 to start the CBPP3, ECB states that the CBPP3 (together with ABSPP and TLTROs) will "futher enhance the transmission of monetary policy, facilitate credit provision to the euro area economy, generate positive spillovers to other markets and, as a result, ease ECB's monetary policy stance, and contribute to a return of inflation rates to levels closer to 2 %.". ECB buys under both programmes a different form of securitisated assets. Central bank purchases gives banks

[2]See decisions ECB/2014/40 and ECB/2014/45.

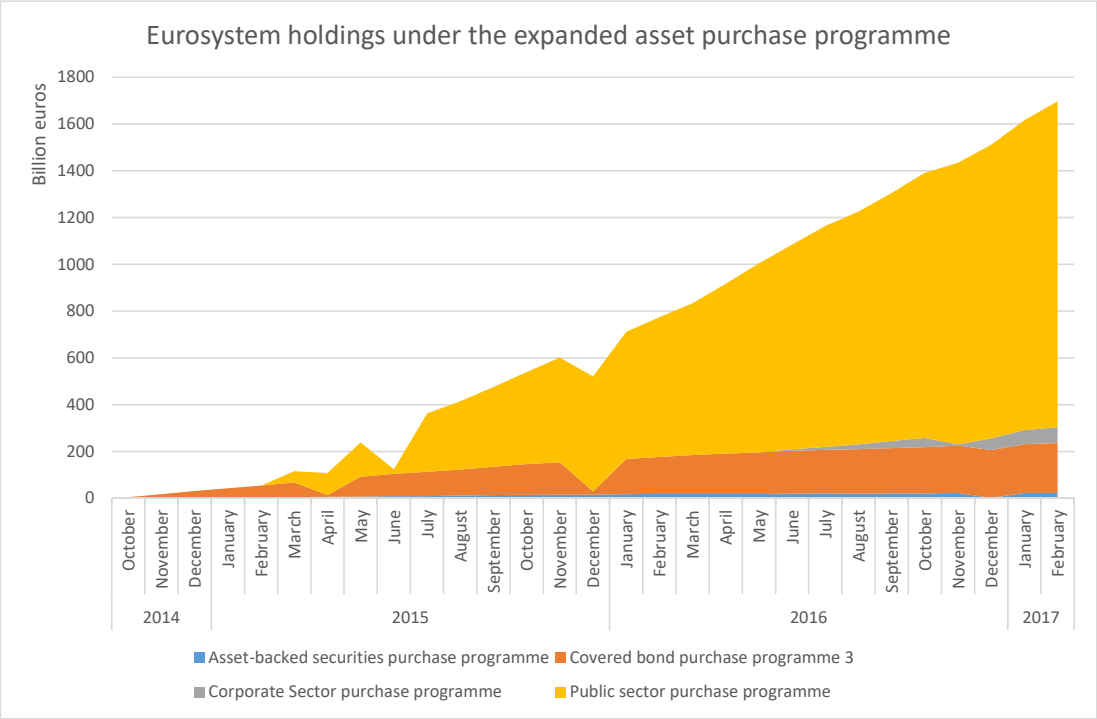

Figure 1: Eurosystem holdings under the APP

an incentive to back their assets and sell them to central bank[3].

ECB announced the public sector purchase programme (PSPP) on January 2015 and started the purchases on the following March. The PSPP expanded the before mentioned ABSPP and CBPP3 to cover also euro area government, agency and EU institution bonds. (Andrade et al., 2016). The announcement day of the PSPP is considered in the literature to be the birth date of the whole extended asset purchase programme (APP). This means that the CBPP3 and ABSPP are parts of the APP even though they were introduced before the start of the APP. On its decision (ECB/2015/10) ECB states that the motive for starting PSPP is to maintain price stability. The PSPP covers nominal and inflation-linked central government bonds and also bonds issued by recognised agencies, regional and local governments, international organisations and multilateral development banks located in the euro area. Purchased bonds can have a negative yield as long as the yield is above the deposit facility rate. Some of the assets that are bought under the PSPP are available for securities lending to ensure the liquidity of purchased assets. (ECB/2015/10).

Latest addition to ECB's purchase programmes is the corporate sector purchase programme (CSPP). The programme was announced on 10th of March 2016. On the press release Mario Draghi said that "the CSPP will provide further monetary policy accommodation and contribute to a return of inflation rates to levels below, but close to, 2% in the medium term". CSPP expanded the previous asset purchase programmes by starting the purchases of corporate bonds. The purchases under the programme started on the 8th of June 2016. CSPP is a very recent programme and because of that, it is the least studied of the ECB's purchase programmes. The main goal of my thesis is to assess the possible effects and transmission channels of

[3]According to Duca et al. (2016) Fed's QE has increased the corporate bond issuance globally.

the CSPP.

The eligibility criteria of the CSPP is based on the Eurosystem's collateral framework, just like in all of the other ECB's purchase programmes. If the asset does not fulfil all of the collateral eligibility criteria[4], it can not be purchased under ECBs purchase programmes. Collateral framework defines what kind of assets are eligible as collateral for Eurosystems monetary policy operations. Assets with any kind of complex structure are not allowed. Eligible assets need to have fixed and unconditional principal, meaning that for example assets with equity-linked or any kind of conditional principal are non-eligible. The coupon structure of the assets needs to be simple and easily determined. Coupon can be either fixed, zero, multi-step or floating, bound by one of the accepted reference rates. Besides the principal and coupon structure, eligibility criteria defines also requirements for the status of the assets. Eligible asset need to have a senior status, meaning that it is not subordinated to the rights of other assets of the same issuer.

To be eligible, asset[5] needs to have an Investment Grade credit rating[6]. The credit rating of the asset is the primary rating to be used, but if it is does not exist, then the issuers credit rating can be used. If the asset or the issuer does have a feasible credit rating, then the guarantor's credit rating is used. If the asset has several acceptable[7] ratings different for each other, the best one is used. To be eligible, the asset needs to be admitted to trading on one of the acceptable markets. ECB publishes a list of acceptable markets as well as all of the eligible assets on its website regularly.

[4]Collateral eligibility criteria is defined on Guideline (EU) 2015/510.

[5]or the issuer or guarantor of the asset

[6]Credit rating of at least BBB-.

[7]Eurosystem approves ratings from the following rating agencies: Moodys, S&P, Fitch and DBRS.

Besides the collateral eligibility criteria, there is also specific criteria that assets need to fulfil before they can be purchased under CSPP. The purchased bonds need to be euro-denominated bonds and have a maturity between six months and under 31 years. Low minimum maturity ensures that corporate bonds issued by small companies can be bought to the programme. Purchasable bonds need to be issued by non-financial corporations and they are not allowed to have a parent company that is a financial corporation. Purchased bonds can be bought from the primary or secondary markets, with certain purchase limits. The purchases are done by six national central banks (Belgium, Germany, Spain, France, Italy and Finland). Each of the central banks have their own set of countries, whose bond market issues they are responsible for. (ECB 2016/16).

Financial crisis have forced central banks to use their creativity and implement new monetary policy measures. Central banks have attacked the protracted economic situation with different kind on liquidity inserting operations and extensive asset purchase programmes. Market has been very sensitive to the announcement and even exact wordings of the central banks and the importance of thorough forward guidance has become an important part of the monetary policy.

3 Review of Previous Literature

Studies regarding the asset purchase programme has increased in the 2000s and in the 2010s. The start of the extensive asset purchase programmes of Japan, the Fed, Bank of England and ECB has increased the demand for research on purchase programmes, their effects on macroeconomic variables and their transmission channels. With no doubt the Fed's QE has been researched more than any other central bank's programmes. However, there exist a large amount of studies regarding other central bank's programmes. The studies of the benefits of the asset purchase programmes usually agree with the effect of the programme and disagree with the magnitude and persistence. Event study is a common method used but also different kind of vector autoregression models have been conducted (SVAR and BVAR). Gertler & Karadi (2013) have developed a theoretical model to study the purchase programmes. Several possible transmission channels regarding the purchase programmes exist. In this chapter, I will introduce the most common ones.

Asset purchase programmes were studied in a theoretical perspective even before they were implemented. According to Chen et al. (2012), before the asset purchase programmes were implemented, they were criticised from a theoretical perspective. These critiques were based on the irrelevance result in Wallace (1981). Also, if asset purchase programmes are examined in a New Keynesian model of Eggertsson and Woodford (2003), the asset purchase programmes are completely ineffective. Exchanging reserve injections to assets would be a neutral operation in this framework. (Chen et al., 2012) Clouse et al. (2000) examines what could be the possible monetary policy tools when nominal short-term interest rate is close to zero. Their study is focused on the US and the monetary policy choices of Fed. They find out that Fed can stimulate the economy with Treasury purchases when stimulus created by lowering the interest rate is not enough.

"An event study looks at the reaction of the financial markets to news." (Gürkaynak & Wright, 2013). Event study is a popular method for studying the immediate effect, that the announcement of some event, had in the financial markets. I concentrate on studies that use the announcement of the asset purchase programme as their event. Most of these kind of studies examine the effect of programme announcement to bond yields[8], but also the announcement effects of equity prices[9] and interest rates[10] have been studied. The bonds whose yields are being studied are usually the ones that are purchased under the programme in question. This means that several studies regarding ECB's or Bank of England's purchase programmes use government bond yields as their dependent variable. Studies regarding the Federal Reserve's purchase programmes study the effect of the programme announcement on Treasury yields or Mortgage-Backed Security yields, depending on the programme being studied.

Results of the event studies are unanimous that the announcement of purchase programme lowered bond yields. The time that the effect took to take place and the level varies between studies. This was due the fact that different programmes affect the yields through different transmission channels. The financial situations were not fully homogeneous in the US, UK and Europe on the time of the programme announcements. Altavilla et al. (2015) points out that the programmes that were started right after the collapse of Lehman Brothers had larger effects, because they were implemented on a much more turbulent financial situation. Other varying thing between the event studies is the time between the announcement and the yield reaction. Liquid bond market reacts very fast to new market information. However,

[8]See Altavilla et al. (2015), Altavilla & Giannone (2016), Altavilla et al. (2016), Andrade et al. (2016), D'Amico & King (2013), Falagiarda & Reitz (2015), D'Amico et al. (2012), Joyce & Tong (2012), and Krishnamurthy & Vissing-Jorgensen (2011)

[9]See Haitsma et al. (2016) and Bernanke & Kuttner (2005)

[10]See Gagnon et al. (2010)

purchase programmes have been introduced in times, when the bond market has not been very liquid. Joyce & Tong (2012) point out, that it is possible that the announcement effects have taken even days to occur when the Bank of England's first asset purchase programme was announced[11].

Usually yields of the bonds that were eligible for purchased had significant announcement effects. Nevertheless, some studies argue that the effects were persistent and others doubt that. Andrade et al. (2016) points out, that the decrease in sovereign bond yields[12] after ECB's announcement of the PSPP was equally persistent, than the change caused by a policy rate change. They found out that the announcement of the PSPP decreased bond yields by 12 basis points and the implementation of the programme decreased yields for additional 14 basis points. Altavilla et al. (2015) studied also the effects of PSPP announcement on bond yields. On their study, the announcement decreased bond yields by 30-50 basis points, depending on the length of the event window. Martin & Milas (2012) state that even though Fed's and Bank of England's programmes decreased yields, the yields rose later back to their previous levels. They state that this may mean, that either the effect was not persistent, or another force has larger effects to yields. In addition, some programmes had spill over effects to yields of bonds that were not purchased.

In addition to event studies, vector autoregression models have been used to study the effects of purchase programmes. Studies[13] show that the purchase programmes had a positive impact on economic output and prices. Altavilla et al. (2016) studied the effects of ECB's announcement of OMT programme. They found out that the announcement had a positive impact on credit and economic growth in Spain and

[11] In the beginning of 2009

[12] They studied the effects of Italy's and Germany's sovereign bond yields

[13] See Kapetanios et al. (2012), Schenkelberg & Watzka (2012), Wieladek & Pascual (2016) and Weale & Wieladek (2016).

Italy. Wieladek & Pascual (2016) noticed that the output effects were larger in the UK and US than in Europe.

Studies have found evidence of several transmission channels through which the purchase programmes have affected the economy. The active transmission channels depend on the qualities of the bonds being purchased and the prevailing financial situation. The channels that are found effective most often are the portfolio balancing channel[14] and signalling channel. The terminology used when assessing the transmission channels is quite mixed and the same channel can have different name in different studies. Also the hierarchy of different channels and its subchannels varies between studies.

Altavilla et al. (2015) state that the transmission channels of purchase programmes can be divided into "broad channels" and "narrow channels" based on the amount of spillovers that the programme has to market segments other than the targeted ones. Usually the studies that use event study as their methodology are divided so, that the announcement effect on yields is studied first and after that the possible transmission channels are being studied separately after that. Weale & Wieladek (2016) point out that when using a structural VAR-model, the possible transmission channel's contributions can not be directly estimated.

Portfolio rebalancing channel is the channel that comes up in almost every study regarding the asset purchase programmes. Portfolio rebalancing means that when the central bank purchases assets from the private sector, and by doing so, it replaces the purchased assets with less-risky, short-term bank reserves. Therefore, the central bank reduces the risk borne by the private sector. The private sector is not

[14]Sometimes referred also as asset valuation channel. See Andrade et al. (2016).

willing to sell their assets to central bank, if the expected return of the asset does not decrease. This leads to increase in the asset's price and decrease of yield. (Gagnon et al., 2010). Studies[15] found evidence supporting the portfolio rebalancing channel, but they differ on the risk type that is reduced during the purchases. Portfolio rebalancing channel is usually divided into different subchannels, the most common ones being duration risk channel and local supply channel.

Duration risk is one type of risk, that the central bank can reduce by purchasing bonds from the private sector. Bonds with long duration are more sensitive to the possible changes in the interest rate, than the shorter ones. Bonds' risk premium increases if there is an increase in the expected policy rate. This means that if an investor buys long maturity bond with interest rate x, he takes a risk that the policy rate will increase during the bond's maturity and that he would have had larger profit from somewhere else. Central bank purchases lower private sector's duration risk and give them an opportunity to take more risk with some other asset types. This can cause spillover to other assets than the ones that were originally purchased under the programme.

The magnitude of effects of the duration risk channel depend on the assets that the central bank purchases. If the central bank purchases risky assets, the effect to the economy through duration risk channel is larger. Risky asset is an asset that has a long maturity and/or counterparty risk. (Andrade et al., 2016). Duration risk is usually studied by examining the differences of yield changes on programme announcement dates between different bond maturities. If the yield decrease is larger on long maturities, that may be caused by decreased duration risk. Studies have found evidence supporting duration risk in ECB's PSPP (Andrade et al. (2016)),

[15]See Clouse et al. (2000), Altavilla et al. (2015), Gagnon et al. (2010) and (2011), Joyce et al. (2011)

FED's LSAP1 and LSAP2 (D'Amico et al. (2012), D'Amico & King (2013)), Bank of England's QE (Joyce & Tong (2012)). There is also some theoretical models describing the duration risk channel. The most used one is from Vayanos & Vila (2009)[16].

Other form of portfolio rebalancing channel is the local supply channel[17]. Altavilla et al. (2015) states that if the arbitrageurs in the market are extremely risk-averse, they will not purchase riskier assets to replace the ones bought by central bank. Instead, they will buy only assets with same maturity than the ones purchased under the purchase programme. This will cause the yields to decrease more on the assets that have same maturity as the ones purchased by the central bank. Local supply channel causes also a yield decrease of assets that are not being purchased, but have same maturity structure than the purchased assets. (Altavilla et al., 2015). Local supply channel are found to be stronger in a more segmented markets (Eser & Schwaab, 2013).

Central bank's monetary policy changes gives a signal to the market about possible future policy changes. This is called the signalling effect. When the central banks announces a purchase programme, it gives a signal to the market that it will not increase the policy rate right away. When central bank is buying large amount of assets with long duration, it exposes itself to the risk of losses if the policy rate would increase during the maturity of the bonds. This gives creditability for the central bank to keep the policy rate low for longer. (Andrade et al., 2016). Studies regarding the purchase programmes found evidence supporting the signalling channel[18],

[16]The model of Vayanos & Vila (2009) has also inspired different kind of extensions and simplifications. See for example Altavilla et al. (2015) and Doh (2010).

[17]Local supply channel is also called asset scarcity channel in some studies.

[18]See Andrade et al. (2016), Christensen & Rudebusch (2012), Krishnamurthy & Vissing-Jorgenssen (2011), Wieladek & Pascual (2016) and D'Amico et al. (2012).

but there is also some studies that could not find the signalling channel significant (Weale & Wieladek (2016)).

There is also several other possible transmission channels for purchase programmes. However the portfolio rebalancing channel and signalling channel are the most common ones. Purchase programmes can also affect the economy by increasing liquidity in the market (liquidity channel), increasing banks' lending to the public (credit channel), reanchoring markets long-term inflation expectations (reanchoring or inflation channel), providing capital relief for banks (capital relief channel) or reducing the risk of bondholder paying the asset back before it matures (prepayment risk)[19].

Asset purchase programmes have become more common in the 21st century as new central banks have started asset purchases. Literature regarding the effects of these kind of policy actions has also increased during the past 10 years. Literature regarding purchase programmes is quite unanimous about the effects, but disagrees on the magnitude and persistence. Some of the purchases programmes were introduced in very turbulent financial market situation and that may have further accelerated the results. Purchases affect the economy through different transmission channels. The most common channels are portfolio rebalancing channel, duration risk channel, local supply channel and signalling channel.

[19]The prepayment risk arises when the purchased securities have an option to be paid premature. Gabaix et al. (2007) and Stroebel & Taylor (2016) studied the prepayment risk on US housing market and they noticed that the risk of mortgage owners prepaying their loans was prices in the mortgage-backed securities market.

4 Empirical Strategy

In the empirical part of my thesis I study the immediate effect that CSPP related announcements had on bond yields and the possible transmission mechanisms. Besides the yield effect, I also study the possible changes on interest rate expectations on event dates to determine whether the signalling channel is active. I use event study to examine the yield reactions of two bond indexes and the price reactions of interest rate swap contracts. I also use the Survey of Professional Forecasters (SPF) conducted by ECB, to study the possible changes in interest rate expectations of the forecasters before and after the CSPP announcement.

Several studies regarding asset purchase programmes use event study, when assessing the effect of the policy announcement to financial variables (usually bond or treasury yields). Gürkaynak and Wright (2013) describe thoroughly the methodology of event studies. They state, that the key ingredients for a successful event study is that the researcher is able to measure the event that changes the information set of market participant and the effect of the changed information set on relevant asset prices. Altavilla and Giannone (2016) state that event study is a powerful tool for quantifying the immediate market effect of policy. The hypothesis of event studies is that the new information gained from the policy announcement is immediately absorbed into financial asset prices. (Altavilla & Giannone, 2016)

Even though the event study methodology is an effect tool, it has some weaknesses. Altavilla and Giannone (2016) point out, that the shortcoming of the event study methodology is that it is not very effective for assessing the persistence of policy effects. In the event studies the purchasable bonds' yields are studied before and after the announcement. The length of the event window[20] used in the studies varies from

[20]Event window is the period of time being investigated in the event studies. Small window helps

one hour to two days, depending on the liquidity of the market being investigated. Larger event windows have been used, especially on the studies regarding the US bond market during the start of financial crisis, when the markets were under a lot of stress and the liquidity in the market was low.

I want to compare the yield changes on announcement dates of bonds that are eligible for CSPP purchases and the ones that are not, to see whether there is any spillover effect to non-purchasable bonds. The difficulty of the bond selection is that even though a list of individual bonds eligible for purchases is publicly available, there is not an index that contains just all the CSPP eligible bonds and nothing else. To solve the preceding, I decided to study the effects of the CSPP related announcement on two bond indexes: EUR Investment Grade European Corporate Bond Index (later IG Index) and EUR High Yield Corporate Bond Index (later HY Index). These two indexes have very similar characteristics. The main difference between the indexes is the credit rating of the bonds included. The IG Index consists only bonds that have at least BBB- rating. If the rating is worse than that, the bond is included in the HY Index.

Why does the credit rating of the bonds matter? Bond needs to have at least BBB- rating to be eligible for the CSPP purchases. Because of that, all CSPP eligible bonds are included in the IG Index. The IG Index also includes non-eligible bonds that are close substitutes to the eligible ones. On the contrary, the HY Index does not include any CSPP eligible bonds. The contents of both indexes are described in more detail on chapter 5. I chose to use time period of 1st of April 2015 to 9th of June 2017 in my study. ECB announced the PSPP on January 2015 and that have

to rule out possible other things that might affected the yields besides the policy announcement. Nevertheless, the event window need to be vast enough to cover the possible effects that are not immediate.

affected the bond yields. I do not want to include the PSPP announcement on the time period of my study about the CSPP, because I want to be able to separate the effects of different programmes as accurate as possible.

I follow Altavilla and Giannone (2016) and Altavilla et al. (2015) in the empirical part of my thesis and use the following regression when studying the yield effects of the CSPP related announcements:

$$\Delta y_t = \sum_{j=1}^{k} \lambda_j D_{j,t} + \sum_{s=1}^{m} \delta_s News_{s,t} + \epsilon_t \tag{1}$$

Where Δy_t is the change of the yield of the bond index on day t. Yield change in day t is calculated as a difference between the end of day yields of day t and $t-1$. I have chosen not to include a constant term into the regression. Figures 3 and 4 show no trend during my time frame. I also tested the regression with a constant term and the estimate for the constant was very close to zero. Different from Altavilla and Giannone (2016), I have chosen to use one day event window, because bond market has been quite liquid during the studied time period.

D_t is a dummy variable for the CSPP related announcement dates. D_t is equal to 1 on event dates[21] and 0 otherwise. I have chosen event dates to be such dates on which ECB either announced something regarding the CSPP or hinted about a possible extension of the existing pre-CSPP programmes. I used transcripts of ECB's press releases and Google trends when determining the event dates. The press releases of ECB's Governing Council monetary policy meeting are built so,

[21] All the event dates are listed in the Appendix A.

that first they announce the monetary policy decisions made and after that is a Q&A section, where Governing Council's president Mario Draghi answers questions from the press. Draghi's comments on the Q&A have occasionally hinted about possible future monetary policy decisions, even though the monetary policy rates would have been kept the same in that meeting.

$News_{s,t}$ measures the effect caused by other macroeconomic releases that could have influenced the bond indexes besides the CSPP announcement. Both the IG and HY Index are sensitive to changes in economic conditions. Therefore, it is essential to rule out possible other things that may have affected the indexes. The $News_{s,t}$ is constructed so, that every day t that a new value of variable s is announced, the value of $News_{s,t}$ is equal to the difference between the latest survey value of s and the actual announced value. All the days, that there is no announcement for s, the value of $News_{s,t}$ is zero. If the announced value of s is the same that the value of the latest survey, the value of $News_{s,t}$ is also zero. This is the exactly same approach that Altavilla et al. (2015) use.

I will follow Altavilla et al. (2015) regarding the variables chosen to be included in the $News_{s,t}$, because similar to me Altavilla et al. (2015) study ECB's purchase programmes and the effects of purchase programmes related policy announcements on European bond market. Altavilla et al. (2015) use 40 different macroeconomic variables in their $News_{s,t}$. I started with the same set of variables, but I ended up dropping a couple of them out, because there were no surprise element in these variables during the whole event window. All of their releases were fully anticipated by the market and because of that, the value of $News_{s,t}$ of those particular variables for 0 for every t. I also added two variables: price of oil and change in the difference

of Eonia[22] and ECB's deposit rate. $News_{s,t}$ contains macroeconomic variables for euro area, Germany, France, Italy, Spain and the US. All the data is collected from Bloomberg.

Besides the immediate yield effects, I study the possible transmission channels. I use similar approach as Andrade et al. (2016) and estimate the yield effect of IG and HY Index with different maturities. If the portfolio rebalancing channel, and especially the duration risk channel is active, the CSPP related announcements should have caused a spillover to bonds that are not purchased, in my case the HY Index bonds. If the yields have decreased more for bonds with long maturities, the local supply channel is active. I will also use interest rate swap contracts and ECB's SPF to determine whether the signalling channel is active. Both are effective tools to determine interest rate expectations and the changes that CSPP related announcement had on them.

Interest rate swap contract is a derivative contract where one party agrees to pay pre-determined fixed interest date and another one pays floating interest rate. The reference rate for floating rate part of the contract and settlement date is decided beforehand. On the settlement date only the difference between floating and fixed rate is paid between the counterparties. When the interest rates are expected to rise, the prices of the interest rate swap contracts also rises and vice-versa. Following Krishnamurthy & Vissing-Jorgensen (2011), I use interest rate swaps with different contract maturities on my study to determine how CSPP related announcements affected the interest rate expectations. The reference rate for one day maturity swap is Eonia and for all the other maturities the reference rate is the 6 month Euribor. I will use the following regression when studying the effects of CSPP related an-

[22]Eonia means Euro OverNight Index Average and it is the rate of euro area overnight interbank credit.

nouncements to interest rate swap prices:

$$p_t = \sum_{j=1}^{k} \lambda_j D_{j,t} + \sum_{s=1}^{m} \delta_s News_{s,t} + \epsilon_t \tag{2}$$

The regression is similar to the regression I use when studying the yield effects. p_t is the price of swap contract on day t. Similarly to the yield model, I have also chosen not to include a constant term into the regression. Set of event dates $D_{j,t}$ is the same as in the yield study[23]. $News_{s,t}$ is also otherwise the same as in the yield study, but I have excluded the difference of ECB deposit rate and EONIA[24]. I will examine the effects of the announcement on prices of contracts with different maturities to determine the magnitude of the possible signalling effect.

Other way to measure the changes in interest rate expectations is to examine the results of ECB's SPF (survey of professional forecasters). Andrade et al. (2016) used SPF to determine how the announcement of PSPP affected the interest rate forecasts. I study how the forecasters revised their survey answers regarding ECB's future policy rate on the survey done after the CSPP announcement. SPF is collected four times a year, and I will be particularly interested on the survey made before and after ECB announced that it will start the CSPP.

[23]Descriptions of event dates are describes on Appendix A.
[24]Full list of contents of $News_{s,t}$ is described on Appendix B.

5 Description of Data

I study the reaction of yields of corporate bonds and prices of interest rate swap contracts to the announcements of ECB's CSPP. I will examine yields of two different bond indexes. My study also includes a set of macroeconomic variables that may have influenced the bond yields and swap prices. Data regarding the bond yields, interest swap contract prices and other macroeconomic variables is collected from Bloomberg. The yield I have chosen for my study is the Yield to Maturity. Yield to Maturity is the expected return that the bondholder would get, if he holds the bond until maturity. The frequency of my yield data is daily and the values are the business day's last yield[25]. The price data for interest rate swap contracts is also the EOD-price from each day.

The two indexes that I am using in the yield study are EUR Investment Grade European Corporate Bond Index (IG Index) and EUR High Yield Corporate Bond Index (HY Index). Figures 2 and 3 describe the evolution of yields of both indexes. The announcement date of the CSPP and the dates when ECB announced details of the programme and started the purchases[26] are marked in the figures with grey dotted lines. Both indexes contain euro-denominated corporate bonds that are issued in the European bond market. All the bonds included in the IG Index have a Investment-Grade credit rating. This means that they have at least the rating BBB-. On the contrary, all the bonds included in the HY Index, have a High-Yield level of credit rating, meaning that they have worse rating than BBB-.

Table 1 summarises the contents of the yield data. The yields are calculated for the whole index, bonds with maturities from 1 to 5 years, bonds with maturities from

[25] so called EndOfDay or EOD-value

[26] 10 March 2016, 21 April 2016, 2 June 2016 and 8 June 2016.

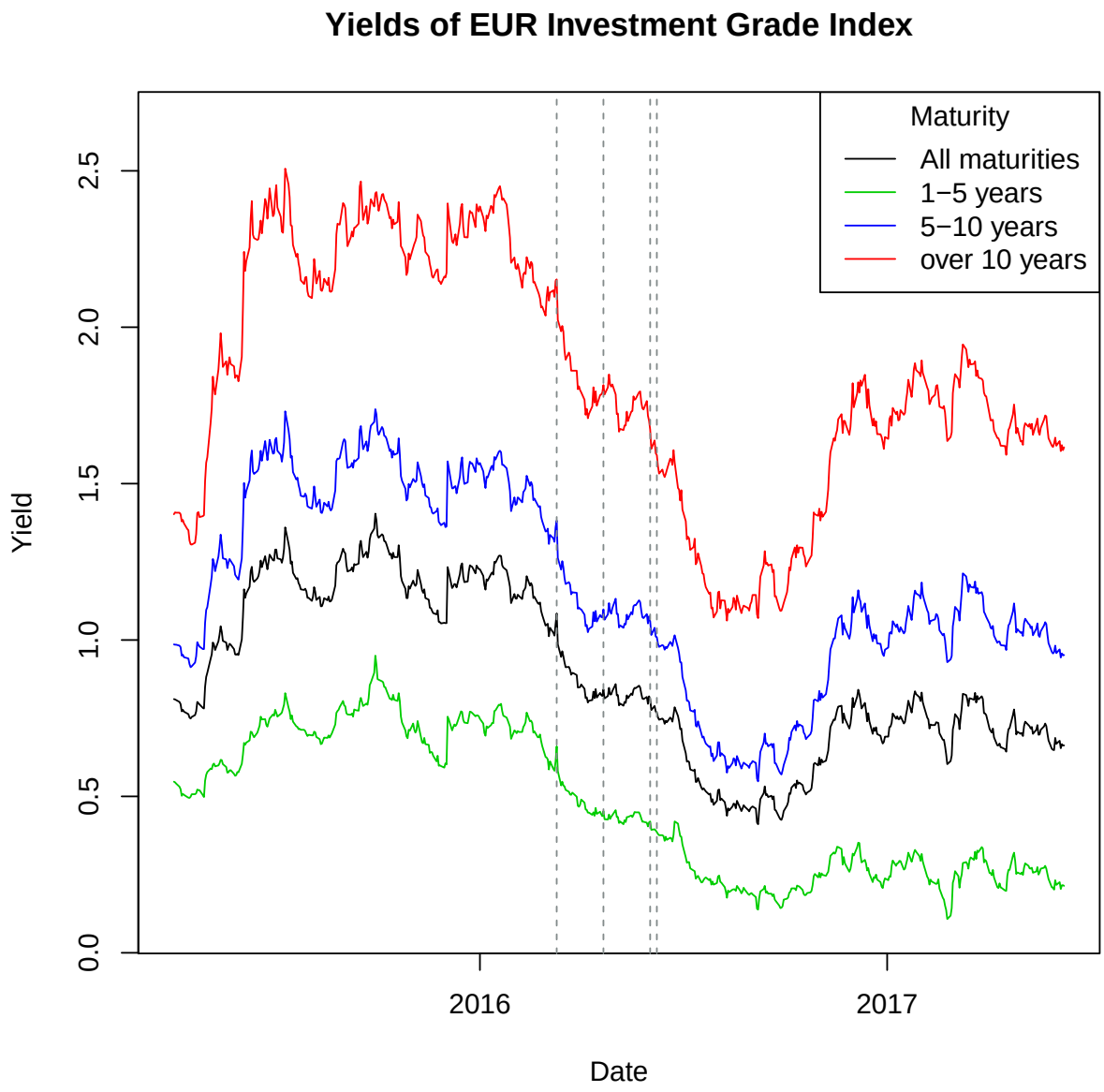

Figure 2: Yields of EUR Investment Grade Index of different maturities

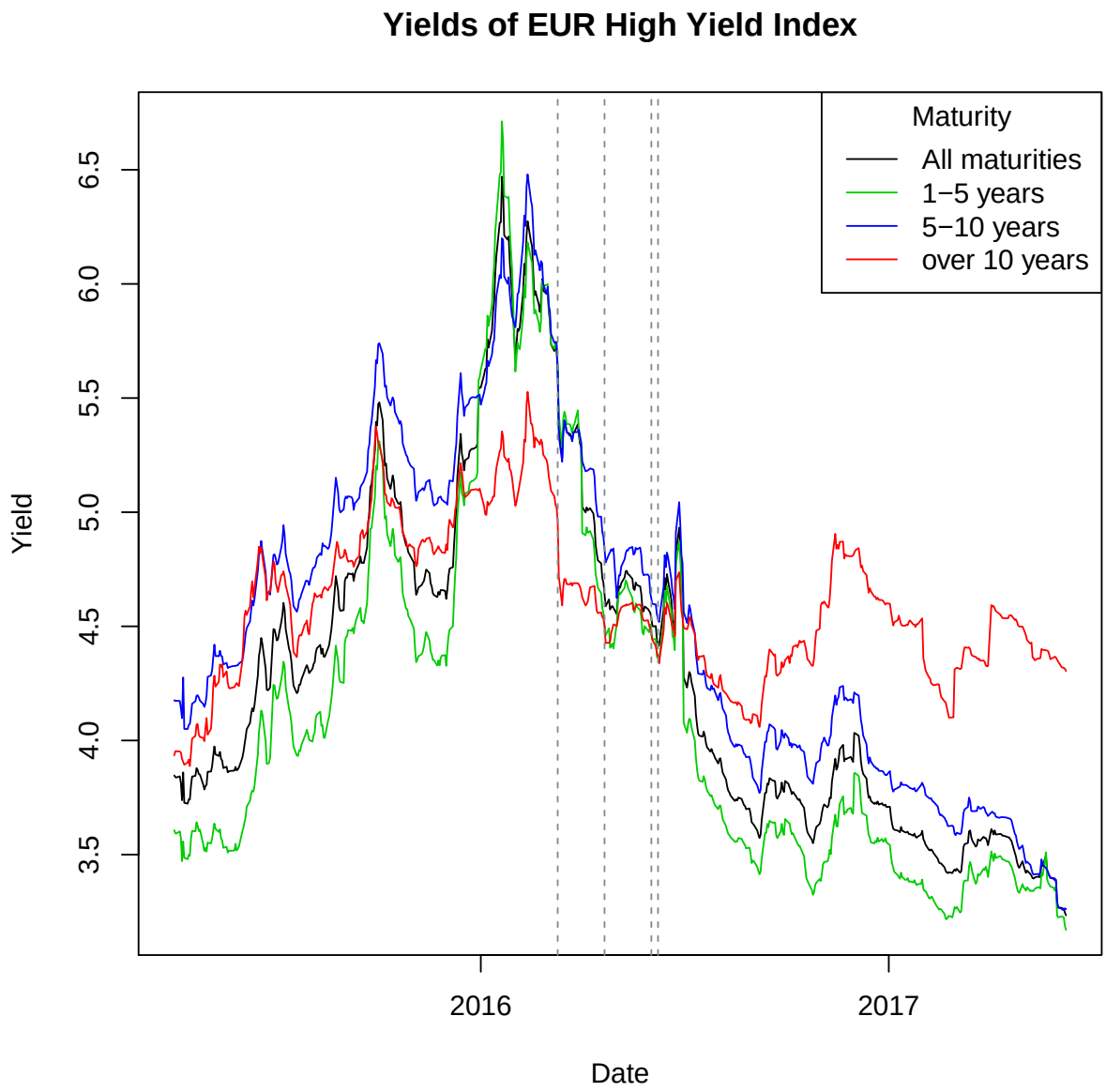

Figure 3: Yields of EUR High Yield Index of different maturities

5 to 10 years and bond with maturity over 10 years. The HY Index is more volatile and has larger yields in all maturities than the IG Index. The bonds included in the HY Index have worse credit rating than the bonds in the IG Index and because of that, the HY Index bonds have larger risk of default and therefore their bonds have larger interest rates. Both indexes are rules-based, market-value weighted indexes. Both indexes consist bonds that have a fixed interest rate, are issued in European bond market and are denominated in euro.

Table 1: Summary of yields of IG and HY Index

Index	N	Mean	St. Dev.	Min	Max
IG (all maturities)	572	0.886	0.261	0.411	1.404
IG (1-5 years)	572	0.467	0.224	0.108	0.950
IG (5-10 years)	572	1.164	0.310	0.548	1.738
IG (over 10 years)	572	1.831	0.395	1.062	2.507
HY (all maturities)	572	4.317	0.757	3.234	6.470
HY (1-5 years)	572	4.147	0.811	3.170	6.712
HY (5-10 years)	572	4.538	0.743	3.258	6.480
HY (over 10 years)	572	4.595	0.328	3.888	5.527

Table 2 describes the sector distribution of the issuers included in the indexes. Largest sectors in the IG Indexes are financials, utilities, communications and consumer discretionary. IG Index with larger maturity have less financial sector bonds and more industrial sector bonds than the shorter ones. It need to be noted here, that the bonds issued by financial institutions are not eligible for CSPP purchases. Because the index also consists ineligible bonds, the possible effects of the CSPP announcement on the IG Index yields might be smaller, than they would be if the index would consist only eligible bonds. Sector distribution in the HY Index is more evenly distributed[27]. The largest sectors are communications, consumer dis-

[27]Apart from the HY Index with bonds that have maturity over 10 years.

cretionary, financials, industrials and materials. The bonds in the HY Index have much shorter maturity in general than the ones in IG Index. Because of that, the HY Index with the maturity of over 10 years does not include as many bonds as the rest of the indexes. Bonds with High Yield credit rating are more risky and used to earn higher profit than the ones with an Investment Grade credit rating. The demand for long term bond with High Yield credit rating might be low and because of that the bonds issued do not have very long maturities.

Both the HY and IG Index includes only bonds that are issued in the European bond market. Nevertheless the residency of the issuer can be a country outside Europe. Table 2 describes the most common issuer countries for bonds with different maturities in the IG Index and table 3 for bonds in the HY Index. Both indexes have similar set of issuer countries, but with different shares. IG Index is more concentrated than the HY Index. Half of the issuers in the IG Index are residents of France, United States or Germany.

Table 2: Sector distribution of IG and HY Index

	Sector	IG (all)	IG (1-5)	IG (5-10)	IG (over 10)	HY (all)	HY (1-5)	HY (5-10)	HY (over 10)
1	Communications	8.70	7.80	8.60	14.10	17.40	13.60	18.30	78.60
2	Consumer Discretionary	8.00	8.80	7.70	5.00	16.80	14.80	19.40	11.60
3	Consumer Staples	7.20	5.70	7.90	11.80	6.70	7.10	6.00	9.80
4	Energy	5.30	4.70	5.50	7.30	4.60	5.20	4.10	0.00
5	Financials	39.80	46.90	37.50	12.60	17.30	19.90	15.00	0.00
6	Health Care	4.40	4.10	4.40	6.30	2.20	1.00	3.90	0.00
7	Industrials	8.90	6.30	9.90	18.40	13.50	16.00	11.20	0.00
8	Materials	5.00	4.90	5.00	5.80	17.80	18.40	18.00	0.00
9	Technology	2.10	1.40	2.50	3.70	2.00	1.30	3.10	0.00
10	Utilities	10.70	9.40	11.10	15.10	1.80	2.60	0.90	0.00

Table 3: Issuer country distribution of IG Index

	Country	IG (all)	IG (1-5)	IG (5-10)	IG (over 10)
1	FRANCE	24.60	20.80	27.60	30.40
2	UNITED STATES	17.20	12.10	20.80	27.80
3	GERMANY	12.60	14.70	10.40	12.60
4	UNITED KINGDOM	8.70	9.70	8.40	5.30
5	ITALY	6.30	8.00	5.30	2.40
6	NETHERLANDS	5.60	6.40	5.30	2.50

Table 4: Issuer country distribution of HY Index

	Country	HY (all)	HY (1-5)	HY (5-10)	HY (over 10)
1	ITALY	18.90	22.00	14.20	34.60
2	FRANCE	12.60	11.70	13.90	11.60
3	UNITED STATES	11.50	5.60	19.40	0.00
4	GERMANY	11.30	12.80	9.60	8.20
5	UNITED KINGDOM	10.50	12.40	8.30	9.80
6	LUXEMBOURG	6.10	6.60	5.30	8.70

Besides the yield effect, I study the effect of CSPP related announcements to prices of interest rate swap contracts and ECB's SPF results. Prices of interest rate swap contracts are collected from Bloomberg for different maturity contracts. The data includes daily EOD prices. Data for ECB's SPF is collected from the ECB's Statistical Data Warehouse. The survey is done quarterly and ECB publishes the data on forecaster-level and also the aggregated forecasts. ECB's SPF measures the forecasters assumptions of future inflation, GDP and unemployment rate. It also collect the forecasts for ECB's policy rate, oil prices, USD/EUR exchange rate and labour costs. All of the forecasts are collected for different horizons. I am particularly interested on the forecast for ECB's interest rate and especially how it have changed after the announcement of the CSPP.

I include a set of macroeconomic variables in my regressions to rule out other possible things affecting the bond yields besides the CSPP related policy announce-

ments. I follow Altavilla et al. (2015) with the selection of these macroeconomic variables. I collect different kind of macroeconomic variables (for example price indices, employment rates and consumer confidence indexes) for the whole euro area, the United States, Italy, Spain, Germany and France. All the used variables and their Bloomberg tickers are listed in the Appendix B.

I am interested for the surprise effect of these variables and because of that I create a surprise component ($News_t$ in my regression) of all these variables. I do this by comparing the announcement value of each variable to its latest survey value. If the announcement have been fully anticipated by the market, the survey value is equal to the actual announcement value and then the announcement should not have any effect to the bond yields. The variables have a value of zero for all the days when there was no announcement made. I started with the same variable set than Altavilla et al. (2015), but some of the variables had to be dropped out, because they did not have any surprise announcements. This meaning that the difference between latest survey value and the announcement value for zero for the whole period of interest. I also include two additional variables: the change of difference between Eonia and ECB's deposit rate and the change in oil price.

All the data ranges from April 2015 to June 2017. The period is chosen so that possible other purchase programme announcements will not affect the results. Especially the announcement of ECB's PSPP[28] needs to be excluded from the data period. Event dates are all the dates the Governing Council of ECB announced the CSPP or additional details regarding the programme and different dates when the ECB hinted about possible extension of the purchase programmes. Detailed descriptions of the selected dates are described in Appendix A.

[28] Announcement date for the PSPP was 21st of January 2015.

6 Results

I start the empirical part of my thesis by determining the event dates. I use ECB Governing Council's monetary policy decisions and Google Trends data when deciding the set of event dates. After the selection of event dates, I study how the yields of two bond indexes reacted on event dates. I examine if there is differences in the yield reaction between the two indexes and between different maturities. Besides the yield effects, I also study how the CSPP announcements affected interest rate expectations. I study the interest rate expectations by examining the changes of prices of interest rate swaps on event dates and the changes on interest rate expectations in the ECB's SPF before and after the announcement of the CSPP.

First step during my research is to choose the set of event dates. Markets can predict the upcoming monetary policy decisions in advance and start to change their behaviour already before the actual policy announcements. It is important, to determine the possible event dates as accurate as possible, otherwise some of the possible effects may not be accounted for. I started my set of event dates with the actual Governing Council announcement dates[29] of the CSPP programme. I used the transcripts of ECB's Governing Council's Press Releases to choose the dates that ECB announced something regarding the CSPP.

I also study what have been the days during which the people have been the most interested about the ECB's Quantitative Easing by using Google Trends. Google Trends shows data about Google searches done by people around the world. Figure

[29] 10th of March 2016, 21st of April 2016, 2nd of June 2016 and 8th of June 2016

4 describes the Google searches done using search words "ECB QE" and "CSPP" during 1st of April 2015 and 9th of June 2017. I have marked the dates that I use in my set of event dates into the figure with grey vertical lines. Google Trends data is normalized, meaning that the date with a largest amount of searches has a value of 100. Figure 4 shows that during my research period, the most searches were done on the date when ECB announced that it will start a new purchase programme for corporate sector bonds on 10th of March 2016. There was an increased amount of searches done before almost every ECB Governing Council's meeting and also on the dates when there were interviews of ECB officials in the media. Figure 4 shows, that market was excepting an QE announcement from the ECB at the Governing Council's meeting on 3rd of December 2015, there is a large spike on that day on the Google searches. Full list of event dates I use and their descriptions are listed in Appendix A.

OLS estimates for changes of IG and HY Indexes yields on event dates are described in Table 5. The estimates are calculated for the IG and HY Indexes with all bond maturities. Columns 1 and 2 contain estimates with unrestricted regression[30] and columns 3 and 4 with restriction. On event dates, the yield of IG Index decreased by 1.2 basis points and the yield of HY Index decreased by 2.4 basis points. When the other possible macroeconomic variables are taken into account, the yield of IG Index decreased for 1.3 basis points and the estimate of yield of HY Index stayed the same as for the unrestricted one. Both estimates have higher significance levels with the restricted model.

Residuals of the restricted model with IG and HY Index data[31] are described on Appendix C. If the model fits the data well, the residuals should be approximately

[30] without $News_{s,t}$

[31] Columns 3 and 4 of Table 5

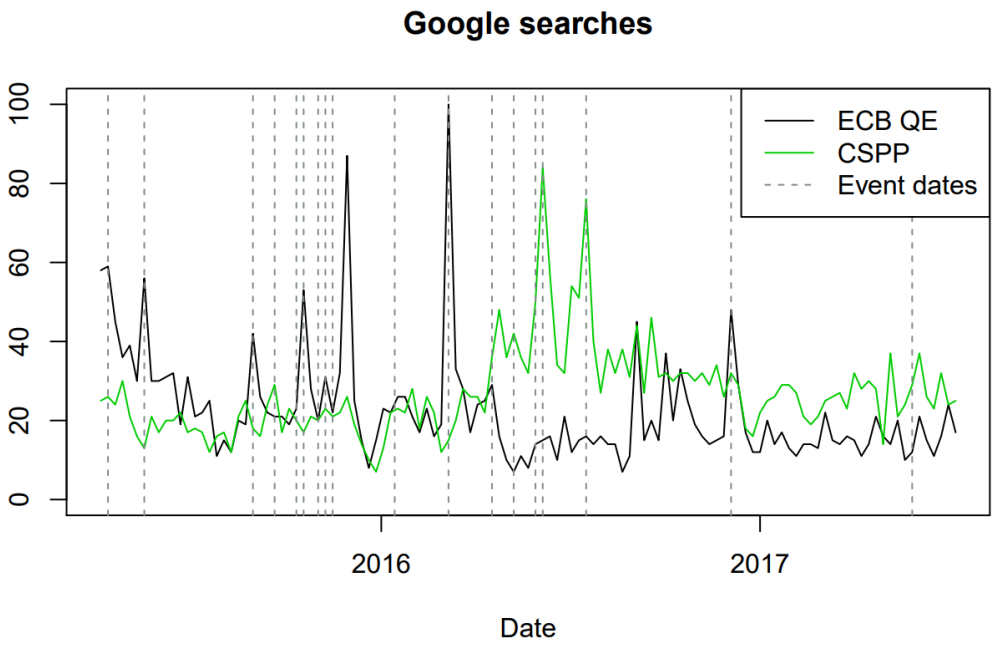

Figure 4: Google searches

white noise. By visually inspecting the residuals, I can say that the IG Index residuals are approximately white noise with for 2 outliers. The residuals of HY Index have larger variance on some points. I also checked the possible heteroscedasticity of the residuals with Breusch-Pagan test that confirmed my visual inspection: there is heteroscedasticity in the residuals for HY Index. I also check the residuals for possible autocorrelation. I did the Durbin-Watson test to the model and find out that there is autocorrelation in the residuals of both indexes. Q-Q plot in Appendix C shows that the residuals of IG Index are more normally distributed than the residuals of HY Index.

Because of the heteroscedasticity, I chose to use the Newey-West standard errors. The estimation for Table 5 and all the other OLS estimates in this thesis include Newey-West standard errors. I test the columns 3 and 4 from table 5 also without Newey-West standard errors and the estimates were exactly the same, but the standard errors were larger. I will use the restricted version of the model for all of the following results, if not stated otherwise.

Table 5: OLS estimates for changes of yields of IG and HY Index with all maturities

	unrestricted		*restricted*	
	IG	*HY*	*IG*	*HY*
	(1)	(2)	(3)	(4)
event date dummy	-0.012^{**}	-0.024^{*}	-0.013^{***}	-0.024^{**}
	(0.005)	(0.013)	(0.004)	(0.009)

Newey-West standard errors in parentheses
*p<0.1; **p<0.05; ***p<0.01

Effect of event dates on IG and HY Index with different maturity bonds are described in tables 6 and 7. Table 6 shows the OLS estimates for change of IG Index yields with bond maturities 1 to 5 years, 5 to 10 years and over 10 years. Table 7 shows

the corresponding estimates for HY Index. On event dates, the yields decreased for both indexes on all maturities. Yields decreased more on event dates for bonds with HY credit rating than for bonds with IG credit rating. Yields decreased on HY Index bonds, even though the bonds in the HY Index are not eligible for CSPP purchases. This supports the portfolio rebalancing channel and especially the local supply channel. According to Altavilla et al. (2015) some of the arbitrageurs have a specific demand for assets with certain maturity. When the central bank purchases assets from them, they replace the purchased assets with other assets that has the same maturity. This seems to be the case on the corporate bond market. The announcement of the CSPP has caused a spillover to assets that have similar maturity structure, but are not eligible for purchases.

IG Index yields decreased on event dates more for bonds with longer maturity. The estimate for yields change for bonds with over 10 years maturity (-1.9 basis points) is double the size of the estimate for bonds with maturity of 1 to 5 years (-0.9 basis points). HY Index yields do not behave similarly. HY Index yields decreased slightly more on the shortest maturity section of 1-5 years maturity bonds, but stayed the same for the rest of the maturities. This results indicates that the ECB's announcement decreased the duration risk for the bonds that were eligible for purchases (IG Index) and therefore the IG Index yield changes were larger on the bonds with longer maturity. Seems that two types of portfolio balancing channel are active on the corporate bond market: local supply channel and duration risk channel. Some of the arbitrageurs changed from IG credit rating bond to bond with HY credit rating with same maturity and some of the arbitrageurs changed from short maturity IG bond to longer maturity IG bond.

Besides the yield effects, I also study how the CSPP related announcement affected the interest rate expectations. Figure 5 shows the change in interest rate swap

Table 6: OLS estimates for IG Index yield changes with different maturity bonds

	IG 1-5 years	IG 5-10 years	IG over 10 years
	(1)	(2)	(3)
event date dummy	-0.009^{***}	-0.017^{***}	-0.019^{***}
	(0.003)	(0.005)	(0.007)

Newey-West standard errors in parentheses
*p<0.1; **p<0.05; ***p<0.01

Table 7: OLS estimates for HY Index yield changes with different maturity bonds

	HY 1-5 years	HY 5-10 years	HY over 10 years
	(1)	(2)	(3)
event date dummy	-0.025^{**}	-0.023^{**}	-0.023^{***}
	(0.011)	(0.009)	(0.006)

Newey-West standard errors in parentheses
*p<0.1; **p<0.05; ***p<0.01

curves on three different dates. Every one of these three dates has its own figure, where the last price of the date and the last price of the previous date are compared. Figure 5 shows that the prices of swap contracts reacted differently to CSPP related announcements depending on the announcement. The announcement of the start of the CSPP made on 10th of March 2016 increased the prices on all maturities and especially for the ones with short maturity. On the contrary, the announcement of CSPP details on 21st of April 2016 also increased the swap contract prices, but the effect was increasing with contract maturity. ECB published information on 21st of April about the maturity structure of the bonds being purchased under the CSPP. The maximum maturity is 30 years. The actual start of the CSPP purchases on 8th of June 2016 did not have an effect on prices of interest swap contracts. This strengthens the theory of Altavilla & Giannone (2016) about market reacting to new information immediately. Because of that, the effect on the announcement date of the programme is larger than the effect on the date when the purchases are started. Market has already absorbed the new information before the actual purchases.

Table 8 describes the OLS estimates for the change in prices of the interest rate swap contracts on a set of event dates relating to CSPP[32]. Upper part of the table shows unrestricted estimates [33] and lower part of the table shows the restricted estimates. The estimates and their standard errors are smaller when the regression takes into account other possible macroeconomic variables than just the event dates. New information published on event dates, decreased the prices of the swap contracts with smaller maturities and increased the prices of the contracts with longer maturities. Prices of contracts with maturity of 1 day, 18 month and 3 years decreased, while contracts with maturities of 6, 9 and 15 years increased. The effect was larger on the most short and long maturities. The price of 1 day interest rate swap decreased by

[32]Event dates are listed on the Appendix A.
[33]without $News_{s,t}$

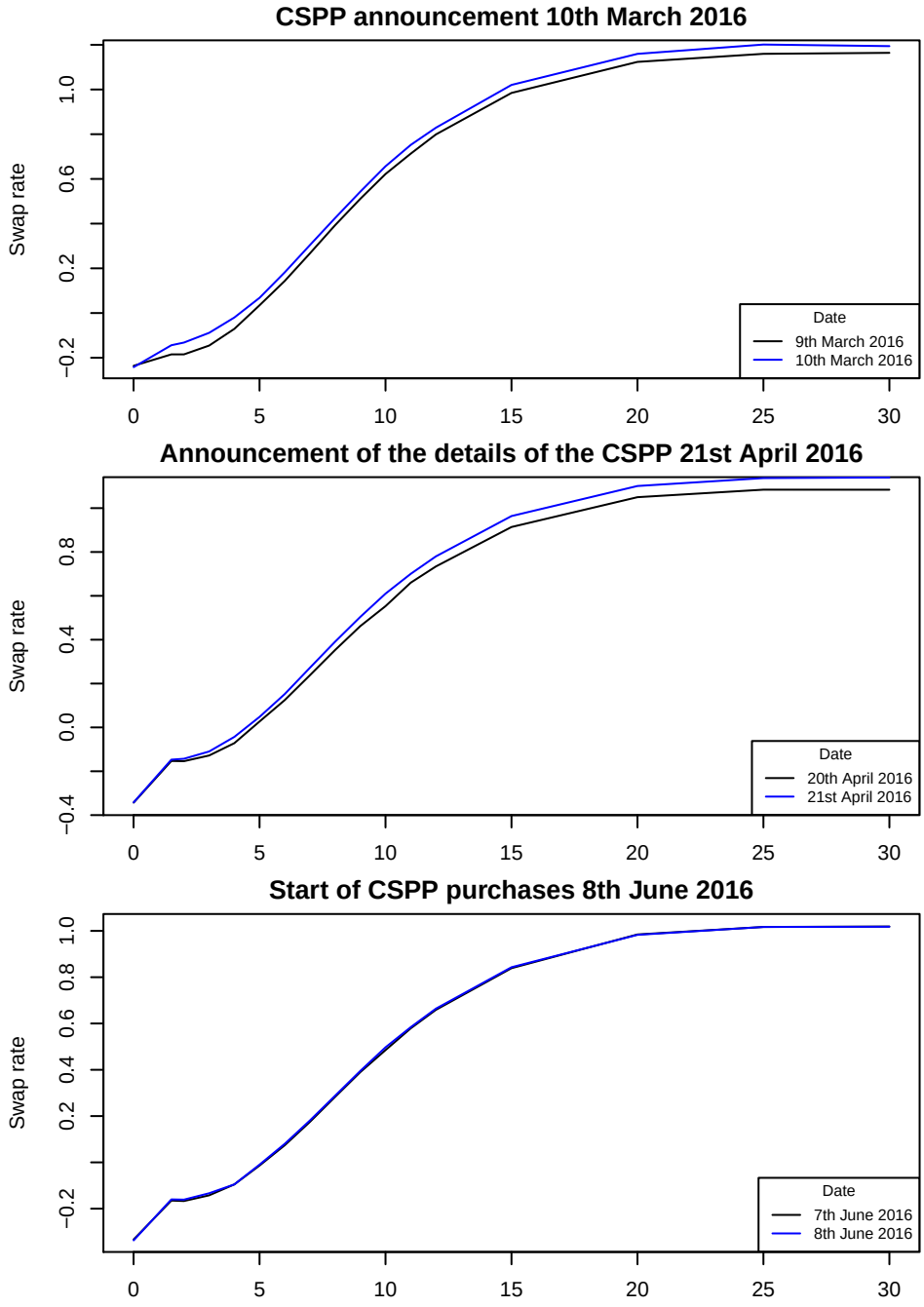

Figure 5: Interest rate swap curves

19.3 basis points and the price of 15 year contract increased for 102.2 basis points. Results suggest that the announcement of the CSPP changed the market expectations for ECB's future policy rate decisions and therefore also the prices of swap contracts. This supports the signalling channel, the announcement of the CSPP programme successfully gave a signal to the market that ECB will not increase the policy rate in the near future.

I do the same diagnostic checks for the model with interest rate swap contract prices than I did to the model with IG and HY Index yields. The residual plot and Q-Q plot for 18 month interest rate swap are described in the Appendix C. Contracts with other maturities had similarly behaving residuals so to avoid unnecessary repetition, I chose to document only the residuals of the 18 month swap contract. Visual inspection of the residuals shows that there is a clear pattern on the residuals. Breusch-Pagan test and Durbin-Watson test confirms that the residuals are heteroscedastic and autocorrelated. It can also be seen from the Q-Q plot that the residuals are not normally distributed. Because of the heteroscedasticity, I have used Newey-West standard errors when estimating the price effects (Table 8). The model clearly fits better to describe the yield changes than the swap price changes. The autocorrelation of the residuals indicates that $News_{s,t}$ does not include all variables that have an effect to the contract prices.

Table 8: OLS estimates for prices of interest swap contracts with different maturities

	Unrestricted					
	1 day	18 months	3 years	6 years	9 years	15 years
	(1)	(2)	(3)	(4)	(5)	(6)
event date dummy	-0.213^{***}	-0.085^{**}	-0.019	0.292^{***}	0.653^{***}	1.120^{***}
	(0.062)	(0.034)	(0.031)	(0.075)	(0.146)	(0.242)
	Restricted					
	1 day	18 months	3 years	6 years	9 years	15 years
	(1)	(2)	(3)	(4)	(5)	(6)
event date dummy	-0.193^{***}	-0.078^{***}	-0.018	0.268^{***}	0.597^{***}	1.022^{***}
	(0.027)	(0.021)	(0.023)	(0.040)	(0.061)	(0.089)

Note: Newey-West standard errors in parentheses
*p<0.1; **p<0.05; ***p<0.01

Besides the swap contracts, one method for determining the changes in interest rate expectations is to examine the results of ECB's Survey of Professional Forecasters (SPF). Figures 6 and 7 describe the expectations of ECB's policy rate 3, 6, 9 and 12 months ahead from the time of the survey. The date on the horizontal axis is the survey date. ECB announced that it is going to start the CSPP on 10th of March 2016. SPFs conducted before and right after the announcement are marked with vertical lines into the figures. It is clear, that the forecasters revised their interest rate forecasts downwards after the announcement of CSPP on all of the forecast horizons.

Figures 5 and 6 show that the forecasters were very unanimous until the announcement of the CSPP. After that, there has been more variation in the replies. The grey areas around the average line describe the densities of the replies. There is more variation in the forecasts with longer horizons. This is reasonable, given that forecasting the interest rate is harder for longer time horizon. Year can be a long time for economy and the probability of something surprising happening increases with time.

I used data from Google Trends and the transcript of ECB Governing Council's monetary policy meetings and based on these chose 20 event dates. I used the selected event dates and a set of macroeconomic variables to determine how the yields of IG and HY Indexes reacted to CSPP related announcements. I found out, that the announcement decreased yields on both indexes, even though the HY Index does not include any bonds that are eligible for purchases. This spillover indicates, that local supply channel is active. I also noticed that yields of the IG Index decreased more with bonds that have longer maturity. The result indicates that the duration risk channel is active on the IG Index bonds. CSPP related announcements decreased IG Index bond yields by 1.3 basis points and HY Index yields by 2.4 basis points.

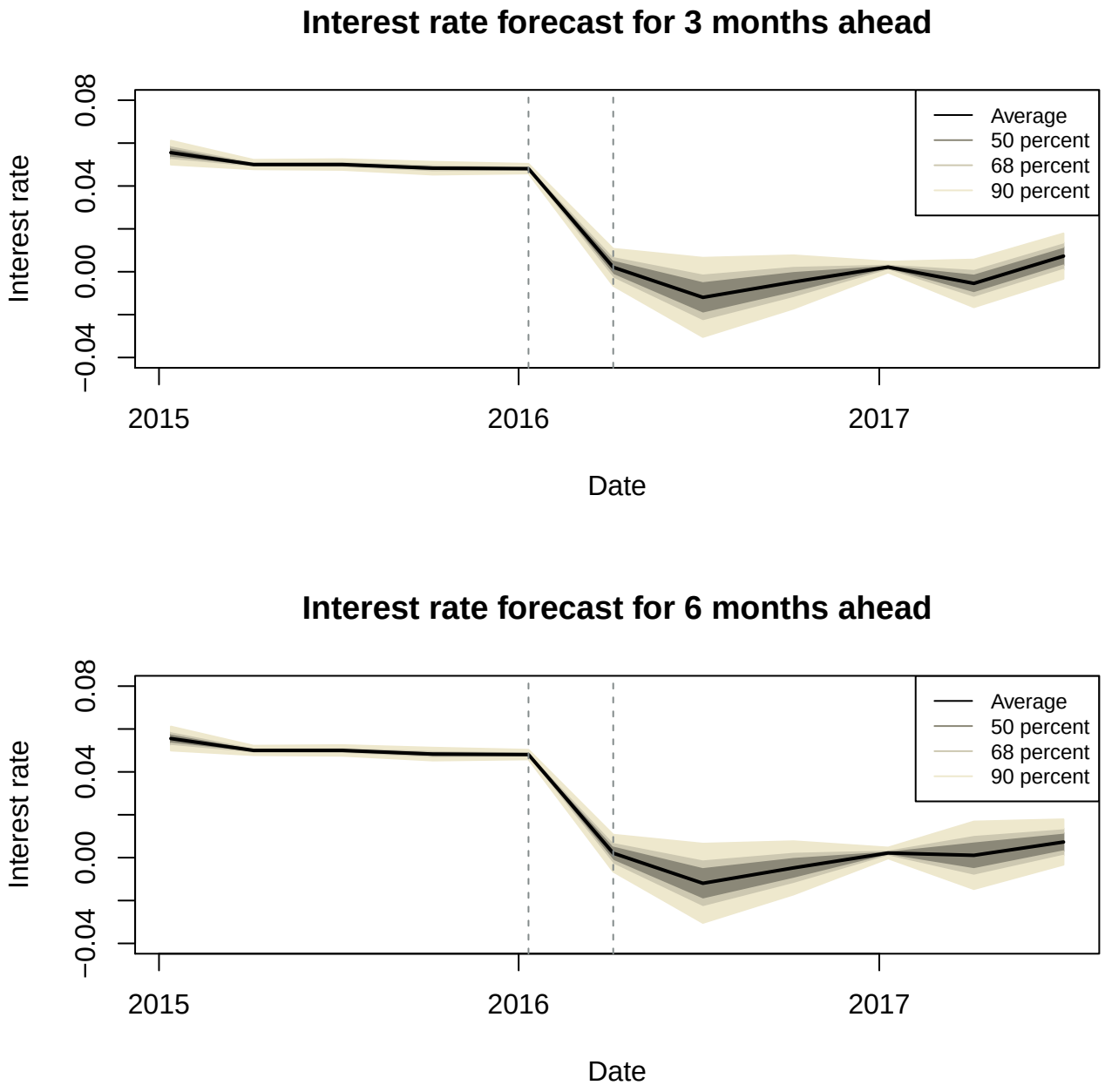

Figure 6: ECB's SPF: Interest rate expectations

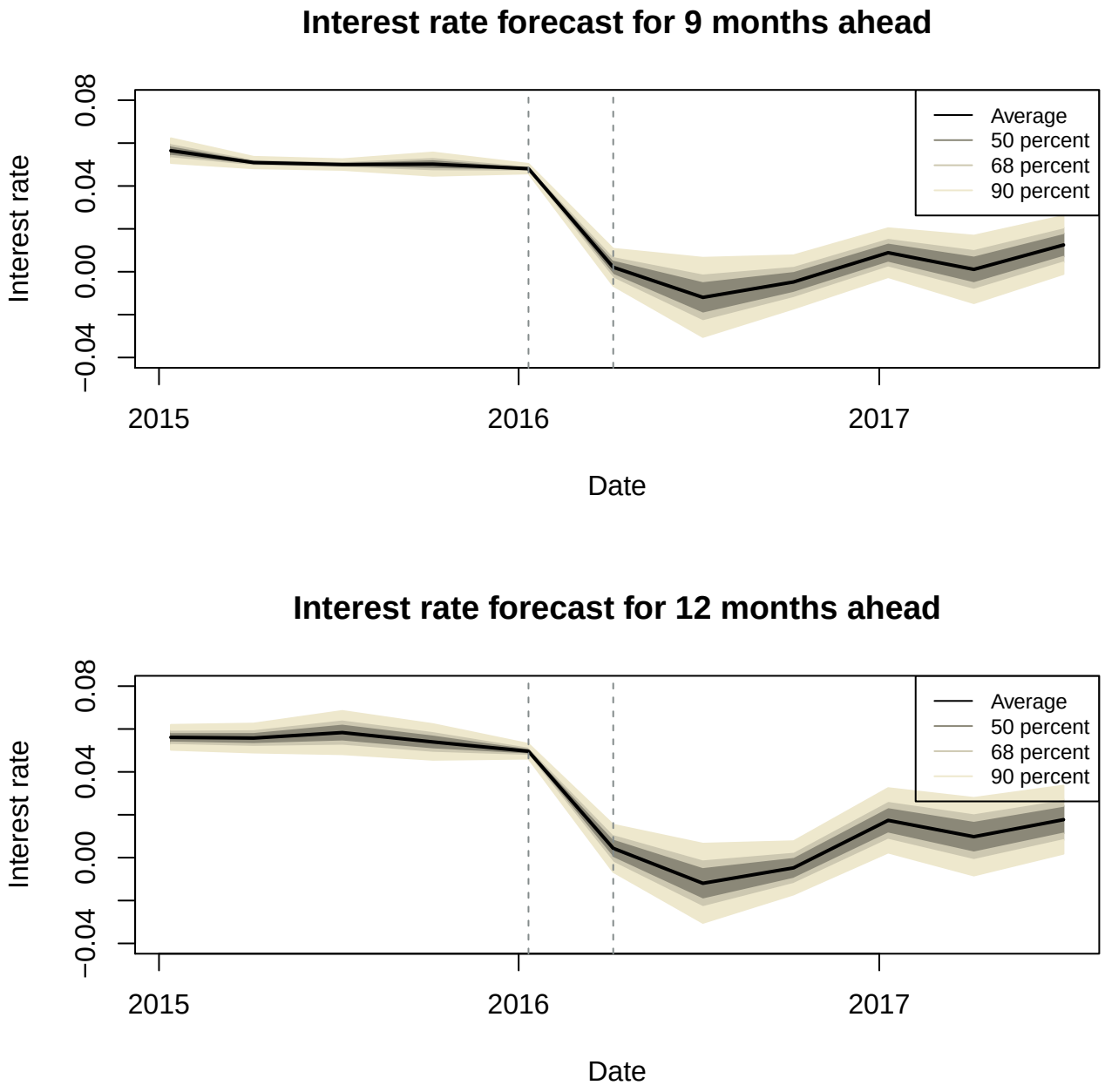

Figure 7: ECB's SPF: Interest rate expectations

The effect is smaller than the ones that previous researchers have found on PSPP[34]. The relatively small effect of the CSPP may be due the small purchase volumes of the CSPP in relation to PSPP and the fact that the indexes I investigated include also non-purchasable assets. Also, CSPP was implemented on more stable financial situation than the PSPP.

I used interest rate swap contracts when studying the possible effects of CSPP announcement on expectations of ECB's future policy rate. I used same event dates as in the yield study and almost same set of macroeconomic variables. I found out that the CSPP related announcements decreased prices of interest rate swaps on small maturities and increased the prices on longer ones. Prices of the interest rate swap increases when the interest rate expectations increase. I also used ECB's SPF to assess the possible changes the CSPP announcement had on forecasters' interest rate expectations. Results implicate that the announcement of the CSPP decreased short-term interest rate expectations. This indicates that the signalling channel is active.

[34]Regarding Altavilla et al. (2015) PSPP decreased yields by 30-50 basis points and according to Andrade et al. (2016) by 26 basis points.

7 Conclusions

In my thesis I study the effects of ECB's corporate sector purchase programme (CSPP) related policy announcements on corporate bond yields and assess the possible transmission channels. I do an event study with 20 event dates. The event dates include meetings of the Governing Council that announced details of the CSPP and speeches by officials of the ECB related to the possible expansion of existing purchase programmes. I use Google Trends when choosing the set of event dates. Besides the event dates, I also include a set of other macroeconomic variables that may have affected the bond yields. When assessing the possible transmission channels, I study how and in what magnitude the yields of different maturity bonds reacted to the CSPP announcements. I also study how large was the possible change in expectations for ECB's policy rate on event dates.

The importance of extensive asset purchase programmes have increased during the past decade. Various central banks have announced purchase programmes of different asset types. The need for studies regarding different purchase programmes have increased. Purchase programmes operate through different transmission channels. It is important to understand the transmission mechanism to fully exploit the potential benefits of the purchase programmes. CSPP is ECB's most recent, and therefore also the least studied purchase programme. Purpose of my thesis is to determine what kind of effects the CSPP related announcements had in the bond market and also what were the transmission channels in use.

All the data on my study ranges from 1st of April 2015 to 9th of June 2017. All the data is either from Bloomberg or from ECB's Statistical Data Warehouse. I use two bond indexes whose yield changes I study. One of them includes bonds that have an Investment Grade credit rating and that are eligible for CSPP and the other one

includes bonds with High Yield credit rating that are not eligible for purchases. My data includes also a set of macroeconomic variables (price indices, employment rates and consumer confidence indexes). I also study the price changes of interest rate swap contracts of different maturities on the same set of event dates.

My results show that the CSPP related announcements decreased bond yields of both indexes. Yields of the HY Index decreased more than the yields of IG Index. The decrease for HY Index bonds was the same size with all maturities. Yields of the IG Index decreased more on the longer maturity bonds. I found evidence supporting the portfolio balancing channel, duration risk channel, local supply channel and signalling channel. Other channels may be active as well, but examining further channels would be out of the scope of my thesis.

Results are in line with the other studies regarding ECB's previous purchase programmes. On other studies the programme announcements also decreased yields. Studies regarding the ECB's PSPP implicate a larger yield decrease than my results. This is reasonable considering the purchase volumes of the PSPP and CSPP. Public sector bonds are purchased by multiple times larger quantities than the corporate bonds. PSPP was announced little over a year before the CSPP and the financial situation in Europe was more unstable on the announcement time of the PSPP.

The form of future monetary policy, after the economy has recovered, is still unknown. Currently, central banks have massive holdings of assets purchased under various programmes and the dissolution of the purchase programmes need to be done carefully and will probably take several years. Forward guidance will be on important role when ECB starts to shut down the purchase programmes.

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Appendices

A List of event dates

Date	Event details
15 April 2015	Monetary policy meeting of the Governing Council. ECB President Mario Draghi's comments on the Q & A section of the meeting regarding possible scracity of ECB's QE programmes.
19 May 2015	Comment of ECB Governing Council member Christian Noyer about possible further monetary policy actions.
3 September 2015	Monetary policy meeting of the Governing Council. Draghi's comments on the Q & A section of the meeting regarding the flexibility of ECB's purchase programmes.
22 September 2015	Comment of ECB head economist Peter Praet regarding the possible adjustments to the purchase programmes.
15 October 2015	Comment of ECB Governing Council member Ewald Nowotny about Europe's poor economic condition.
22 October 2015	Monetary policy meeting of the Governing Council. Draghi's comments on the Q & A section of the meeting regarding possible further monetary policy stimulus.
3 November 2015	Draghi's speech at the Reception for the Opening of the European Cultural Days in Frankfurt.
11 November 2015	Comment of ECB Governing Council member Ignacio Visco about possible new monetary policy instruments.
17 November 2015	Praet's comments about inflation expectations.

Date	Event details
19 November 2015	Publication of Account of the monetary policy meeting of the Governing Council on 22 October. Account revealed that the Governing Council was planning further monetary policy easing on October's meeting.
20 November 2015	Draghi's speech at the Frankfurt European Banking Congress.
21 January 2016	Monetary policy meeting of the Governing Council. Draghi's comments on the Q & A section of the meeting regarding possible new monetary policy actions.
10 March 2016	Monetary policy meeting of the Governing Council. The Governing Council announced that it will start the CSPP in the second quarter of 2016.
21 April 2016	Monetary policy meeting of the Governing Council. The Governing Council announced details regarding the CSPP purchases.
13 May 2016	ECB published a Q & A section about the CSPP on their website.
2 June 2016	Monetary policy meeting of the Governing Council. The Governing Council announced the remaining details regarding the CSPP purchases.
8 June 2016	Purchases under CSPP started
21 July 2016	Monetary policy meeting of the Governing Council.
8 December 2016	Monetary policy meeting of the Governing Council. The Governing Council announced that it will expand the EAPP from March 2017 to December 2017.
29 May 2017	Draghi's speech at the Economic and Monetary Affairs of the European Parliament.

B Contents of $News_{s,t}$

Country	**Variable (Bloomberg ticker)**
Euro area	Consumer Confidence (EUCCEMU)
Euro area	CPI MoM (ECCPEMUM)
Euro area	Economic Confidence (EUESMU)
Euro area	GDP SA QoQ (EUGNEMUQ)
Euro area	Industrial Production SA MoM (EUITEMUM)
Euro area	Markit Eurozone Manufacturing PMI (MPMIEZMA)
Euro area	Difference of ECB deposit rate and EONIA
France	Consumer Confidence (FRCCO)
France	CPI YoY (FRCPIYOY)
France	GDP QoQ (FRGEGDPQ)
France	Markit Manufacturing PMI (MPMIFRMA)
Germany	IFO Business Climate (GRFIPBUS)
Germany	Markit/BME Manufacturing PMI (MPMIDEMA)
Germany	Unemployment Rate (GRUEPR)
Germany	ZEW Survey Expectations (GRZEWI)
Italy	Business Confidence (ITBCI)
Italy	GDP WDA QoQ (ITPIRLQS)
Italy	Industrial Production MoM (ITPRSANM)
Italy	Markit/ADACI Manufacturing PMI (MPMIITMA)

Country	**Variable (Bloomberg ticker)**
Spain	Markit Manufacturing PMI (MPMIESMA)
Spain	Retail Sales YoY (SPRSWDSY)
Spain	Unemployment rate (SPUNEMPR)
Spain	CPI EU Harmonized YoY (SPCPEUYY)
United States	Chicago Business Parameter (CHPMINDX)
United States	CPI MoM (CPICHNG)
United States	GDP Annualized QoQ (GDPCQOQ)
United States	GDP Price Index (GDPPIQQ)
United States	Initial Jobless Claims (INJCJC)
United States	ISM Manufacturing (NAPMPMI)
United States	University of Michigan Sentiment (CONSSENT)
United States	Unemployment Rate (USURTOT)
United States	Change in Nonfarm Payrolls (NFPTCH)
United States	Change in Oil price (USD/barrel)

C Diagnostic checks

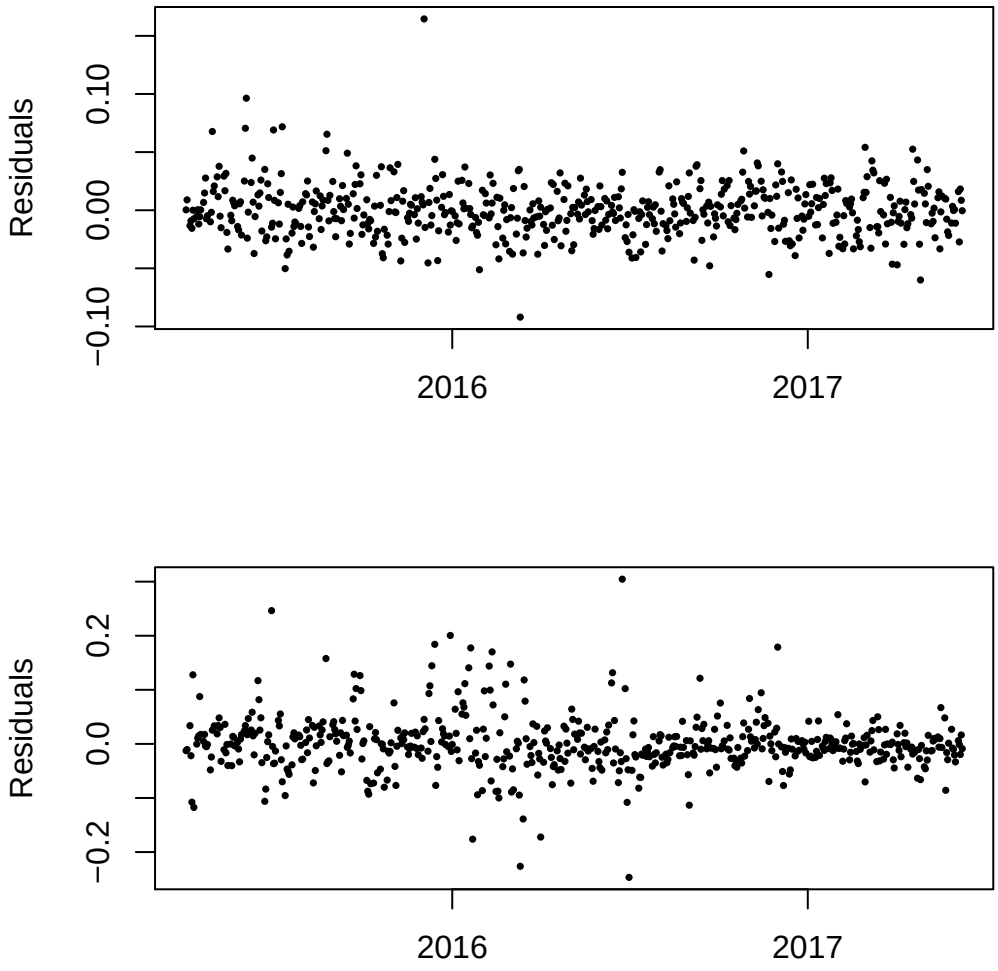

Figure 8: Residuals of model (1) with IG (upper figure) and HY Index (lower figure)

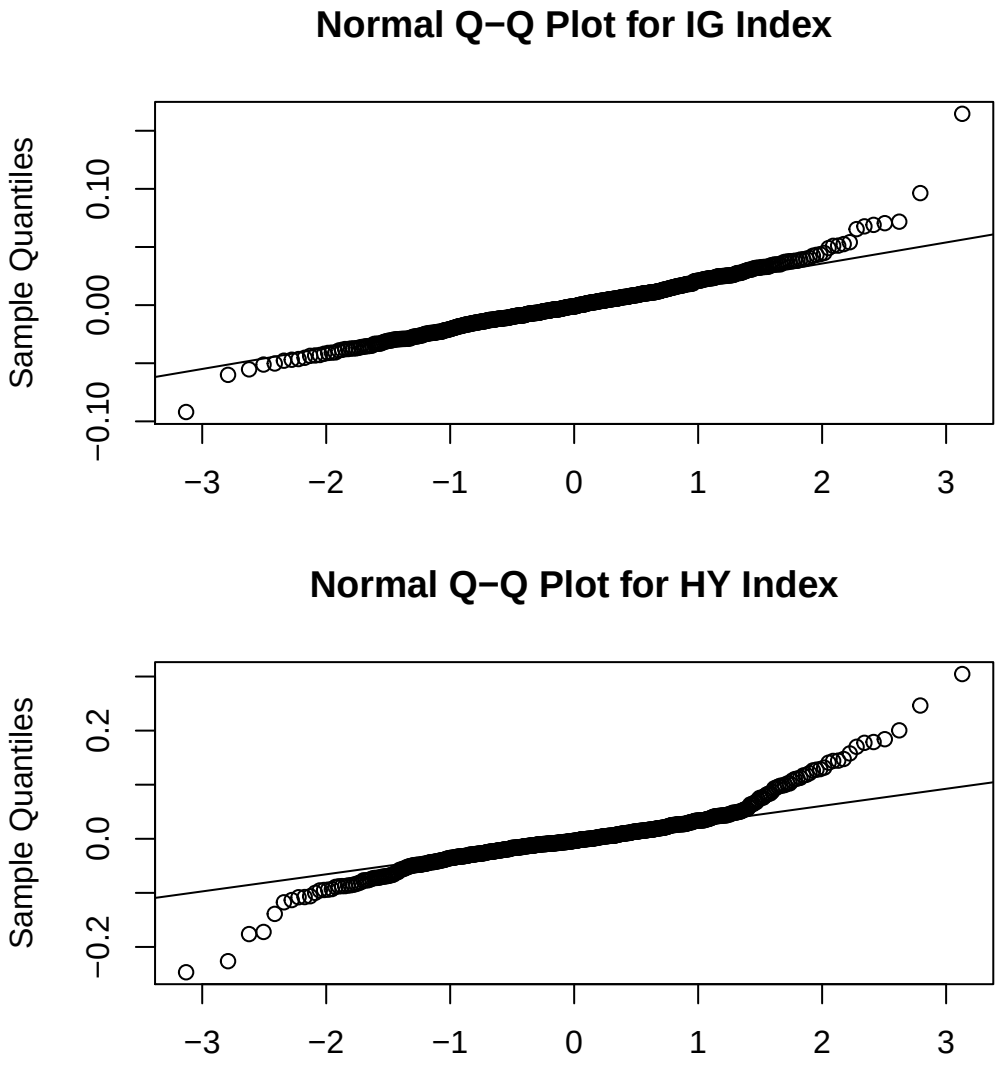

Figure 9: Q-Q plot for IG Index and HY Index residuals

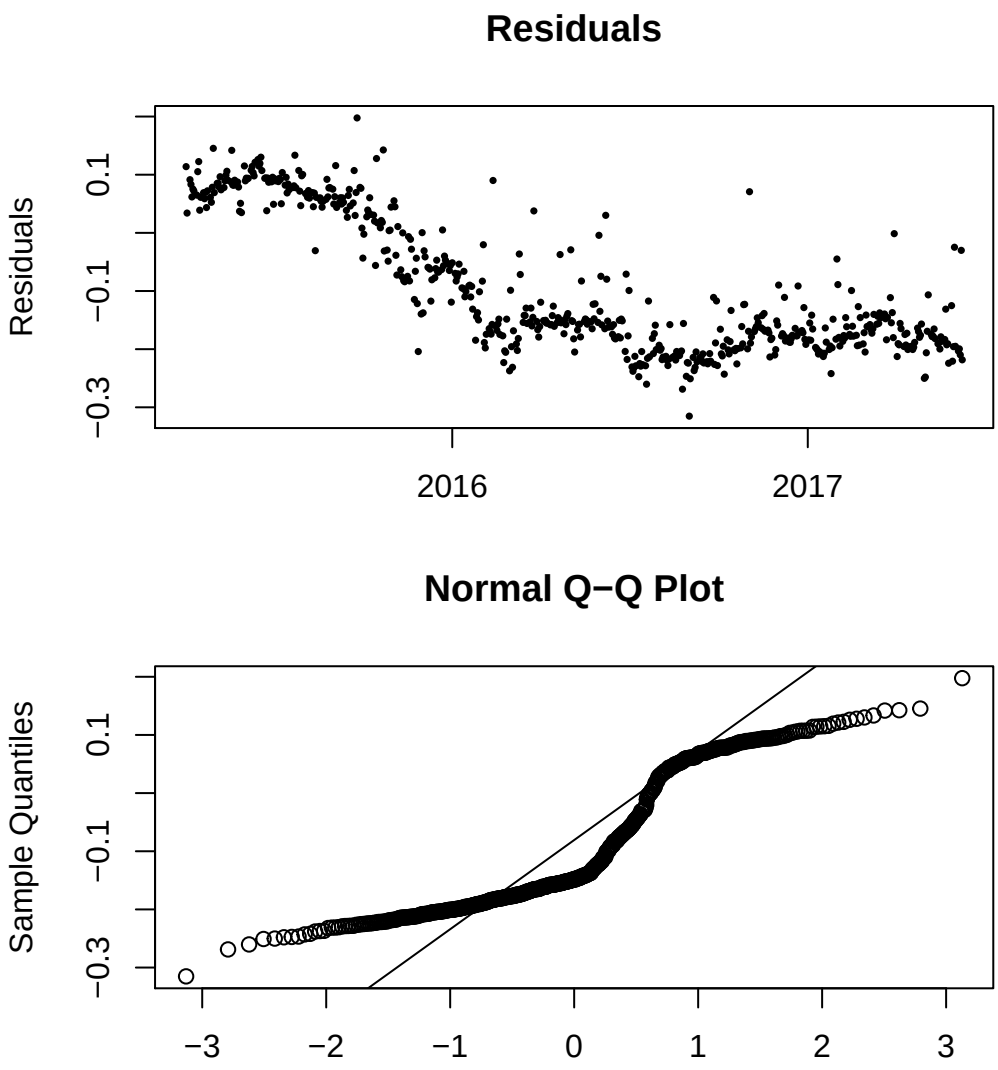

Figure 10: Residuals and Q-Q plot for interest rate swap prices (18 months)